Integrated On-Chip Power for Harsh Environments, Phase I

Completed Technology Project (2018 - 2019)

Project Introduction

CoolCAD proposes a high temperature and radiation tolerant silicon carbide (SiC) technology that is comprised of an integrated circuit and a complementary power device for use in power applications such as spacecraft motor drive modules for robotic science probes on orbiters, landers, and rovers. The proposed on-chip power innovation combines our SiC low power integrated circuit technology with a SiC power device to meet the power needs for robotic science probes and instrumentation with blocking voltage needs < 200 V, and current needs < 3A. The proposed technology has the potential to extend the exploration capabilities and survivability of robotic systems in harsh environments such as those present on the surface of Venus by providing long life and reliable power, and relaxing cooling and shielding needs.

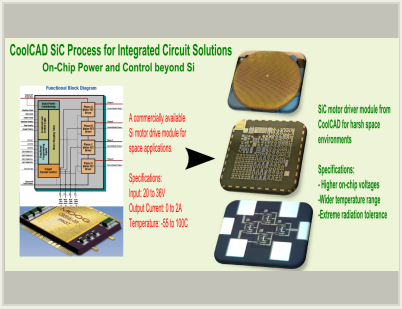
An advancement in spacecraft motor drive modules and power systems for robotic science probes is necessary to extend the scientific mission capabilities and lifecycle for upcoming mission applications such as Europa Clipper and Lander, New Frontiers 2024 (Comet Surface Sample Return, Saturn Probes,Venus In-situ Explorer), Discovery 2028, and also for possible future flagships (2030s and later) such as Titan Saturn System Mission, Neptune Systems Explorer, Saturn Ring Observer, Venus Lander, and others. Especially the Venus surface exploration systems, and Gas Giant orbiters and probes require niche technologies that are high temperature capable and radiation tolerant.

Commercial silicon motor drive modules that are specifically developed for space applications exist; however, such commercial chips work well as long as the temperature and radiation constraints, which are tight, are within the datasheet specifications. The proposed SiC on-chip power solution will significantly increase the safe operating temperature and radiation range of such modules, and open up new exploration possibilities for rovers and landers.

Anticipated Benefits

An advancement in power for robotic science probes is necessary to extend scientific mission capabilities and lifecycle for upcoming mission applications such as New Frontiers 2024, Discovery 2028, and also for possible future flagships such as Titan Saturn System Mission, Neptune Systems Explorer, Venus Lander and others. Additionally, the Venus surface exploration systems and Gas Giant orbiters and probes require niche technologies that are high temperature capable and radiation tolerant.

The SiC integrated on-chip power solution for space applications offers the same weight reduction and efficiency gains for the government and military spacecraft, and therefore we expect the outcomes of this proposal benefit the larger community including private satellite and space companies. This work



Integrated On-Chip Power for Harsh Environments, Phase I

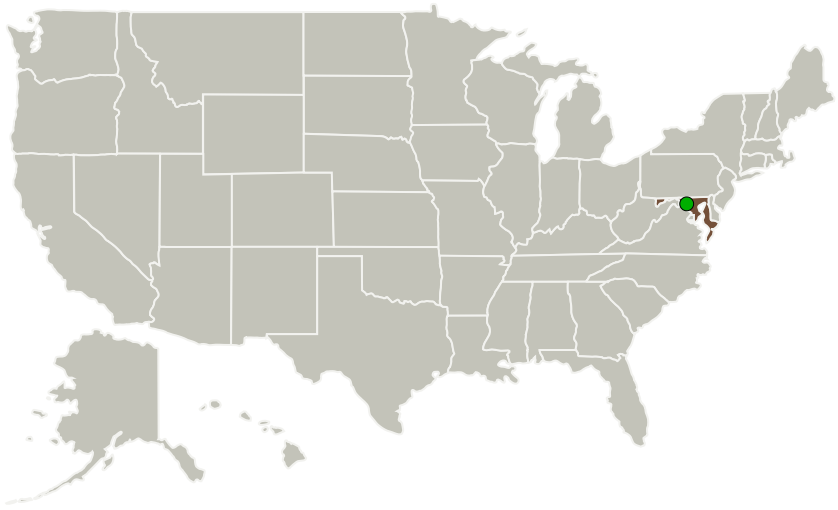
Table of Contents

Integrated On-Chip Power for Harsh Environments, Phase I

Completed Technology Project (2018 - 2019)

would especially benefit space companies such as SpaceX in terms of cost savings. Additional terrestrial high temperature applications such as drill monitoring would benefit from this as well.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
CoolCAD Electronics, LLC	Lead Organization	Industry	Takoma Park, Maryland
Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations
Maryland

Project Transitions

July 2018: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

CoolCAD Electronics, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

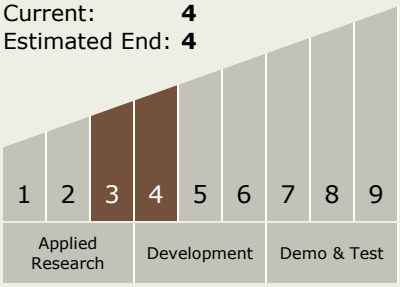
Carlos Torrez

Principal Investigator:

Akin Akturk

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



Integrated On-Chip Power for Harsh Environments, Phase I

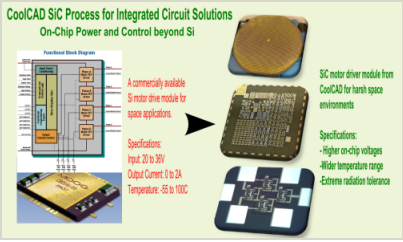
Completed Technology Project (2018 - 2019)

February 2019: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/141124)*

Images



Briefing Chart Image
Integrated On-Chip Power for Harsh Environments, Phase I
(https://techport.nasa.gov/image/129330)

Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.4 Microwave, Millimeter-, and Submillimeter-Waves

Target Destination

Others Inside the Solar System